HI-1801

Microwave Survey Meter
User's Manual

Declaration of Conformity

We,
HOLADAY INDUSTRIES, INC.
14825 MARTIN DRIVE
EDEN PRAIRIE, MN 55344
USA

declare in our own responsibility, that the HOLADAY product described in this instruction manual is in compliance with: EN EMC Directive 89/336/EEC, EN50082-1, EN55011

President
HOLADAY INDUSTRIES, INC.

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HI–1801 Microwave Survey Meter

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Limited Warranty

Holaday Industries, Inc. warrants each model HI—1801 to be free from defects in material and workmanship for a period of one year from the date of shipment to the purchaser. This warranty extends to the original purchaser only, and does not apply to the batteries or to any products or parts subject to misuse, neglect, accident, unauthorized service or abnormal conditions of operation.

In the event an instrument covered by this warranty fails, Holaday Industries, Inc. will, without charge, repair and recalibrate the instrument if returned to their factory within one year of the original purchase—provided that Holaday Industries' examination discloses, to its satisfaction, that the product is defective. Holaday Industries, Inc. may, at its option, replace the product in lieu of repair. If the defect was caused by misuse, neglect, accident, unauthorized service or abnormal conditions of operation, repairs will be billed at a nominal cost. In such cases, an estimate will be provided before work is started, if requested by the purchaser.

For warranty service, contact Holaday Industries, Inc. Provide the serial number of the instrument and complete details regarding the failure mode. You will then be given either service information or shipping instructions. Return the instrument to the factory, transportation prepaid. Repairs will be made at the factory and the instrument will be returned to you, transportation prepaid. Holaday Industries, Inc., assumes no responsibility for loss of, or damage to, products in transit.

Warning!

EXTREME CAUTION IS ADVISED WHEN WORKING IN ENVIRONMENTS WHERE HIGH-INTENSITY ELECTROMAGNETIC FIELDS MAY EXIST AND WHERE CONTACT WITH HIGH VOLTAGE OR HIGH CURRENT CIRCUITS OR APPARATUS IS POSSIBLE. ACCIDENTAL CONTACT WITH OBJECTS OR CIRCUITS OPERATING AT HIGH VOLTAGES OR HIGH CURRENTS CAN BE LETHAL! HOLADAY INDUSTRIES, INC. ASSUMES NO LIABILITY FOR ANY DAMAGES OR PERSONAL INJURY WHICH MAY RESULT FROM

1.0 INTRODUCTION

The HI-1801 Microwave Survey Meter is a rugged, compact, portable instrument that is virtually immune to failure caused by excessive fields or physical abuse. This instrument is acceptable to the US Government Center for Devices and Radiological Health (FDA/CDRH) and to all major microwave oven manufacturers for testing ovens in use and after repair.

This easy to use meter, and the step-by-step instructions in this manual will enable you to easily and accurately measure leakage from your microwave oven.

This manual is divided into seven sections:

1. About the HI-1801
2. Specifications
3. Acceptance
4. Getting Ready
5. Making the Measurement
6. Using the Check Feature
7. What the Measurement Means

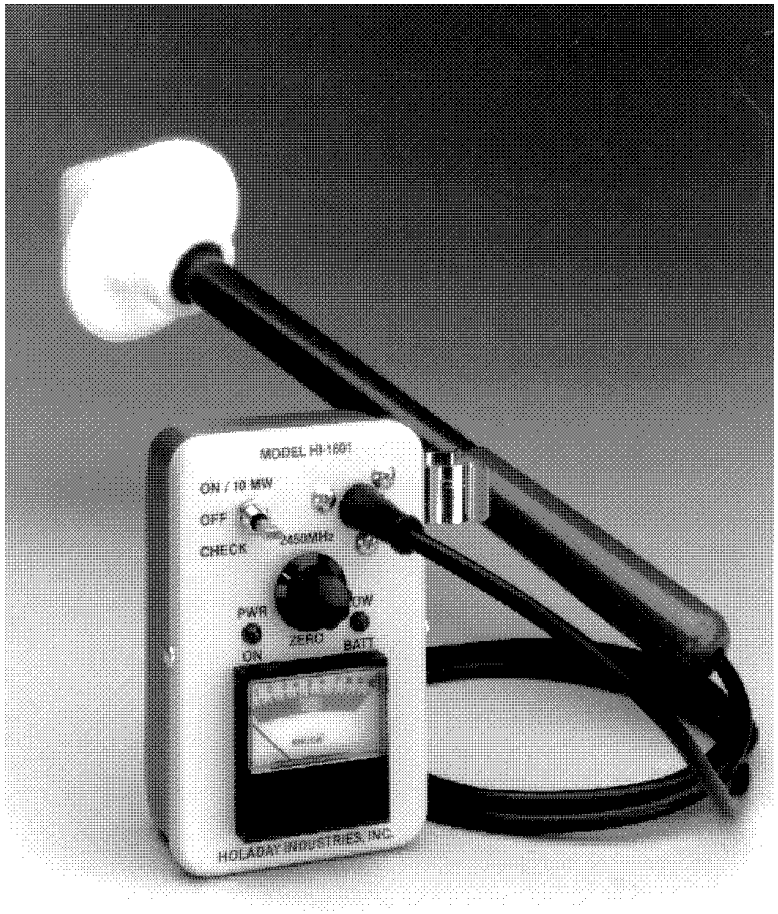

Figure 1
HI-1801 Microwave Survey Meter

2.0 ABOUT THE HI-1801

Description

Microwave leakage (electromagnetic fields) is detected by an array of eight hot carrier diodes housed in the large end of the plastic probe. This antenna array has the unique feature of being able to sum microwave electric fields of any polarization in a plane perpendicular to the axis of the probe. The antenna lobe (effective measuring area) is also very broad, making the instrument easy to use when measuring leakage around an oven door. The spacer cone is designed to provide a 5 cm spacing from the tip of the probe to the center of the array.

This instrument has a single calibrated range of zero to ten (0-10) mW/cm^2. The scale is divided into three zones, with a calibration point at midscale (5 mW/cm^2). If the reading is in the green zone, it is less than 5 mW/cm^2. If the reading is in the red zone, it is greater than 5 mW/cm^2.

NOTE:

The HI-1801 must not be used without the spacer cone in place. Using the instrument without the cone will result in reading errors and may damage the unit.

Unique Features

When testing today's microwave ovens, the observed leakage levels are often well below 1 mW/cm^2. Many of these values are below the sensitivity threshold of the HI-1801.

Observers are often concerned that the instrument may not be operating properly when no leakage indication is noted.

Figure 2
HI-1801 Front Panel

When used on the same oven, low cost microwave leakage indicators may show a significant or even dangerous leakage level. This is due to the lack of damping and to the detection characteristics of the particular meter. The HI-1801 is designed to comply with the requirements of the US Government criteria for testing microwave ovens.

The HI-1801 provides a "check" feature that allows you to check the operation of the instrument at any time while testing a microwave oven. The control switch has two positions, an "ON/10 MW" position and a "CHECK" position.

The "ON/10 MW" position is used for testing microwave ovens in the normal manner.

The "CHECK" position provides an additional uncalibrated, highly sensitive mode for checking meter operation. In the "CHECK" position mode, the meter will respond to very low levels of leakage and will assure you that the instrument is responding to microwave energy. With this increased sensitivity, most ovens will cause some deflection of the meter, verifying proper operation of both the oven and the meter.

After using the "CHECK" mode, return to the "TEST" mode and perform the oven test in the normal manner. Note that meter readings in the "CHECK" mode have no significance; the only purpose of this mode is to verify proper meter function.

Accuracy

The accuracy of this instrument is within ± 1 db (+25%, -20%) when used according to these instructions:

1. Always use a clean Holaday spacer cone. Accuracy will be affected by wear of the cone and by dirt and metallic particles which may become imbedded in the EPS (expanded polystyrene foam - Styrofoam).

2. Hold the instrument case at approximately 45/. The balance of the meter movement causes the needle to move slightly when held horizontally (flat) or vertically (upright). The meter is calibrated while at an angle of 45/ and if it is used at that angle, no additional error will be introduced.

3. The normal operating temperature range is between 60/ and 90/ F. If used outside this range, an additional error will be introduced. This error can be approximated as -0.1% per Fahrenheit degree. The negative temperature coefficient means that the instrument reads high at lower temperatures and low at higher temperatures.

4. The parameters which affect the accuracy of this instrument are listed along with the error contribution of each in the following table.

Parameter	Error (dB)
Calibration - Precision - Accuracy	±0.09 ±0.13
Nonlinearity and AM response	±0.17
Near Field vs. Far Field	±0.29
Receiving Pattern	-0.11
Temperature Response	±0.06
Frequency Response *	±0.04
Polarization *	±0.21
RFI *	±0.04
Drift *	±0.04
Total	+0.96 / -0.81
* Errors combined in RMS manner	

Calibration Method

Each meter is calibrated by placing the probe in a CW (continuous wave) 2450 MHZ electromagnetic field generated by a crystal controlled solid state source. The source feeds an anechoic chamber through a section of waveguide terminating in a slot radiator. Calibration is performed at a level of 5 mW/cm^2 and a standard temperature of 75/ F.

The accuracy of the field is determined by comparing with an LCR (local calibration reference) which is traceable to NIST (National Institute of Standards and Technology [formerly NBS]) through FDA/CDRH (Food and Drug Administration / Center for Devices and

Radiological Health).

Maintenance

The only maintenance that is required is the replacement of the batteries or the spacer cone, should it become damaged or worn. Both items may be purchased from Holaday Industries, Inc.

NOTE:

Do not use the HI-1801 without the spacer in position. To maintain stated instrument accuracy, use only spacer cones provided by Holaday.

Battery Replacement

Remove the two screws that hold the instrument cover in place. Remove the foam block that holds the batteries. Always replace both batteries at the same time. Any nine (9) volt alkaline battery may be used.

Spacer Cone Replacement

The spacer cone must be replaced when worn or contaminated. Simply remove the old cone by pulling straight off the end of the probe. Slip a new cone on, being sure the cone is fully seated on the probe. A polystyrene cone shield is available which provides protection for the relatively soft material of the cone.

The following spare parts and options are available from Holaday:

1. Spacer Cone Kit (Holaday part number 540013) (Includes two spacer cones and four cone shields)

2. Nine Volt Batteries (Holaday p/n 30MN1604) (Duracell MN1604 or equivalent)
3. 600 mL Beaker (Holaday p/n 44600MLP)

Recalibration Service
It is recommended that the HI-1801 be recalibrated every 12 months.

Holaday Industries, Inc. will recalibrate and repair any damaged instrument for a nominal charge. The calibration fee will be quoted on request.

Service Centers
Holaday Industries, Inc. has established factory-authorized repair and recalibration centers in the US and the UK. If your microwave survey meter requires service or recalibration, contact Holaday for the nearest center.

Return Procedures
To return a product, use the following procedure:

Step 1. Briefly describe the problem in writing. Give details regarding observed symptom(s), and whether the problem is constant or intermittent. If you have already talked to Holaday Customer Service about the problem, provide the date(s), the name of the service representative you spoke with, and the nature of the conversation. Include the serial number of the item.

Step 2. Package the probe carefully. Return the product, using the original boxes and packing materials, if possible to:

Holaday Industries Inc.
Attn. Service Department
14825 Martin Drive
Eden Prairie, MN USA 55344

3.0 HI—1801 SPECIFICATIONS

Frequency:	2450 MHZ (± 50 MHZ)
Power Range:	0 -10 mW/cm^2
Accuracy:	± 1 dB
Response Time:	2 - 3 seconds
Overload Capacity:	Continuous 2000 mW/cm^2
Dimensions:	2.09 in. (5.3 cm) x 2.68 in. (6.8 cm) x 4.13 in. (10.5 cm)
Probe Length:	12.00 in. (30.5 cm)
Cable Length:	3.3 ft. (1.0 m)
Spacer:	1.97 in. (5 cm), EPS (Expanded Polystyrene - Styrofoam)

4.0 ACCEPTANCE

Introduction

This section contains information on unpacking and acceptance of the HI—1801.

Unpacking and Acceptance

Step 1. Upon delivery of your order, inspect the shipping container(s) for evidence of damage. Record any damage on the delivery receipt before signing. In case of concealed damage or loss, retain the packing materials for inspection by the carrier.

Step 2. Remove the product from its shipping containers. Save the boxes and any protective packing materials for future use.

Step 3. Check all materials against the packing list to verify that the equipment received matches that which was ordered. If you find any discrepancies, note them and call Holaday Customer Service for further instructions.

Be sure that you are satisfied with the contents of your order and the condition of your equipment before using the HI-1801.

5.0 GETTING READY

Introduction

There are certain things that should be taken care of before testing your microwave oven. It is a good practice to follow these guidelines when using and testing any microwave oven:

DO NOT ATTEMPT TO OPERATE A MICROWAVE OVEN WITH:

1. Any object caught in the door.
2. A door that does not close properly.
3. A damaged door, hinge, latch, or sealing surface.

Preparing the Oven

1. Make sure that the oven is clean and that there is no buildup of dirt around the door seal area.

2. Inspect the door and sealing surfaces, the hinge, and the latch for damage or a loose fit.

3. If the oven has a variable power control or a defrost setting, make sure it is set for full power.

4. In order to make an accurate leakage measurement you must use the specified water load. Fill the beaker to a level of 275 mL with cool tap water and place it in the center of the oven.

5. Set your oven timer for approximately three (3) minutes. If your test takes longer than this, the water may boil. If it does, pour out the water and refill using 275 mL of cool tap water.

Preparing the Meter

1. Remove the meter from the carrying case. Make sure the EPS (styrofoam) spacer cone is intact and firmly seated on the probe. Check the cone for signs of wear or contamination. Replace if worn or contaminated.

2. Turn the ON/OFF switch to either the ON or the CHECK position. If the batteries are low, the "LOW BATT" light will come on. When this happens, the batteries need to be replaced before further testing.

3. The ON/OFF switch must be moved to either the ON or the CHECK position to operate the unit. The "PWR" light will come on when the ON/OFF button is held in either position and the instrument is operating.

4. While operating the ON/OFF switch in the ON/10 MW position, use the large knob to adjust the meter to a ZERO indication. Note that the probe must be in a zero microwave field with no RF energy present for accurate zeroing.

6.0 MAKING THE MEASUREMENT

Introduction
This section outlines the steps that should be taken while measurements are actually taken with the HI-1801.

1. Turn the oven on and proceed with the leakage measurement.

2. Hold the probe by the red handle in one hand and hold the meter in the other hand, with the ON/OFF switch in the ON/10 MW position. Place the tip of the spacer cone against the oven surface, with the probe handle perpendicular to the surface. While testing, hold the meter away from the oven to minimize the possible RF pickup directly from the oven to the meter case.

3. Move the probe slowly, about one inch per second, keeping the cone tip in contact with the oven and the probe handle straight.

4. The areas where leakage is likely to occur are around the door seal, the window, and at ventilation louvers or vents. A damaged or improperly installed magnetron mounting gasket may cause leakage in the control panel area of the oven.

5. Once you have checked all around the door edges, around and across the window, and at any louvers or vents, return to the spot where you noticed the highest reading before.

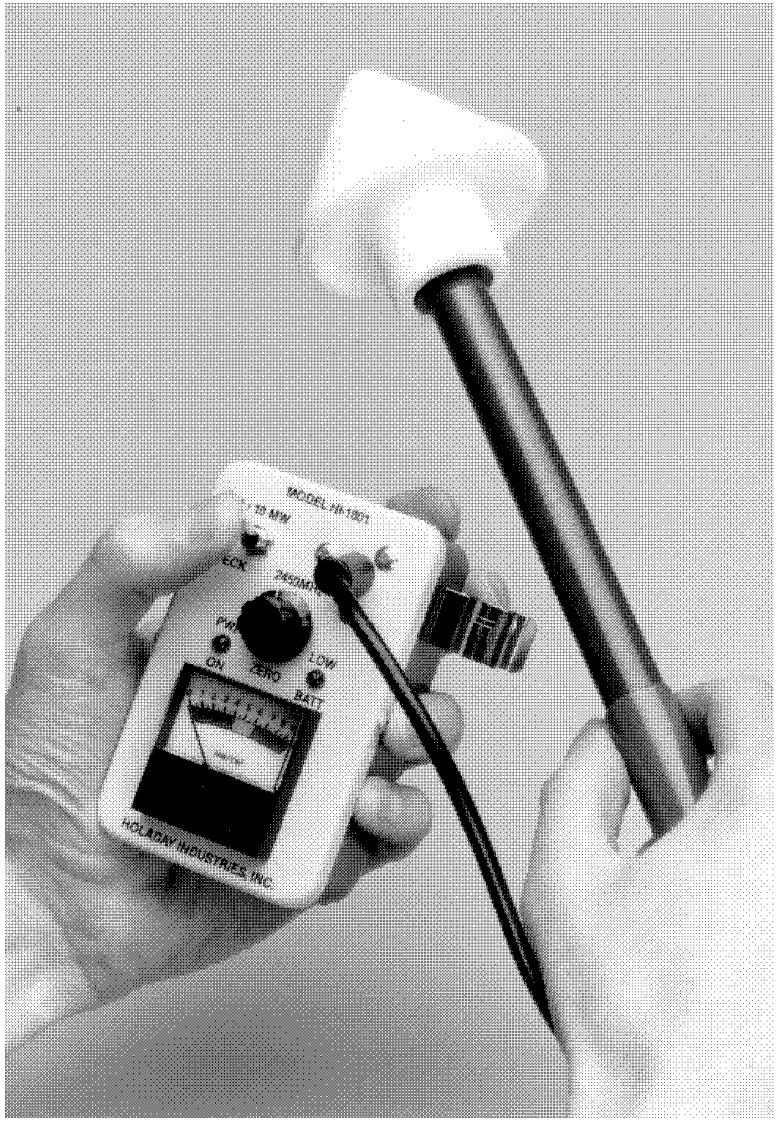

Figure 3
ON/OFF Switch Operation

6. Hold the probe in place over this spot for at least five seconds and watch for the highest needle indication. The reading you obtain is the maximum leakage of your oven.

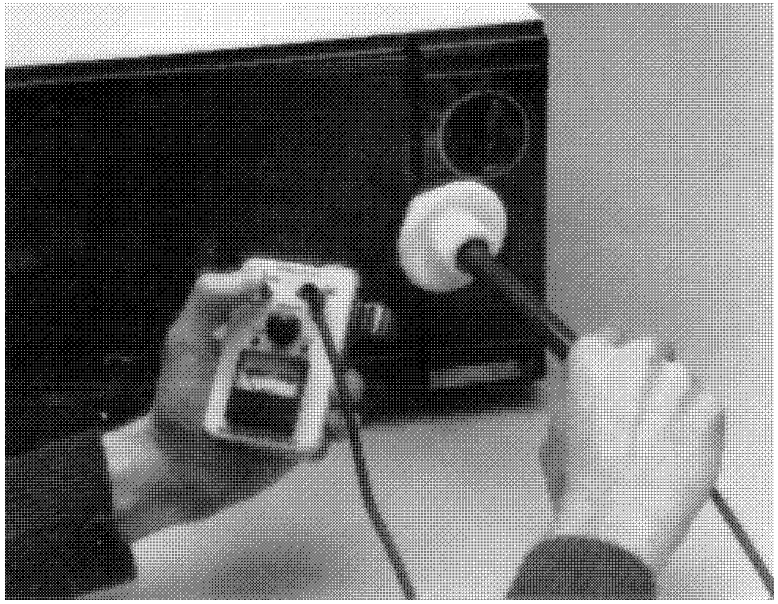

Figure 4
Oven Scanning

7.0 USING THE CHECK FEATURE

Introduction

In the "CHECK" position mode, the meter will respond to very low levels of leakage and will assure you that the instrument is responding to microwave energy. The "CHECK" position provides an additional uncalibrated, highly sensitive mode for checking meter operation.

NOTE:

Meter readings in the "CHECK" mode have no significance; the only purpose of this mode is to verify proper meter function.

1. Hold the ON/OFF switch in the CHECK position and use the large knob to adjust the meter to an indication between 0 (zero) and 1. Note that the probe must be in zero microwave field with no RF energy present.

2. Holding the ON/OFF switch in the CHECK position and the oven operating, move the probe over the door and door gap surfaces of the oven. In the CHECK mode, the sensitivity of the HI-1801 is increased from five to ten fold. Note that it may be necessary to test the oven in a no-load condition momentarily to observe meter deflection.

8.0 WHAT THE MEASUREMENT MEANS

Introduction
The FDA/CDRH (Food and Drug Administration/Center for Devices and Radiological Health) has established the following requirements concerning microwave oven leakage:

> **The power density (leakage) emitted by a microwave oven shall not exceed one milliwatt per square centimeter (1 mW/cm^2) measured prior to acquisition by a purchaser, and thereafter, five milliwatts per square centimeter (5 mW/cm^2).**

5 mW/cm^2 is mid-scale on the 10 MW range. However, many ovens leak so little that you may notice only a small indication. This actual value is sometimes as low as 0.1 or 0.2 mW/cm^2.

If the oven leakage exceeds 5 mW/cm^2, you should contact a service agency recommended by the oven manufacturer, or contact the manufacturer directly. This oven must be repaired to comply with the CDRH safety guidelines.

You may wish to write down for future reference the leakage level, and the model number and serial number of the meter used to make the measurement. Be sure to note the calibration due date of the instrument; for assurance of accurate readings, the microwave survey meter should have been calibrated within the last 12 months.

-- NOTES --